
ANALYSIS OF ROADWAY IMPROVEMENT ALTERNATIVES

TECHNICAL MEMORANDUM NO. 2 for the CIA EXPANSION STUDY

prepared by
Dewberry and Davis
and
— jhk & associates

**for the
Virginia Department of Highways and Transportation**

February 9, 1984

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I. INTRODUCTION

The proposed expansion of the CIA headquarters at Langley, Virginia will result in an increase in the number of persons entering and leaving the site during the morning and evening peak periods. Technical Memorandum No. 1^{1/} analyzed what this increase would mean in terms of vehicular traffic loads at each of the major CIA access points under a range of assumed conditions. Traffic impacts were examined for the year 1986 (the assumed completion year for the CIA expansion) as well as for the year 2005 (the 20-year design horizon for which long range highway plans are prepared).

The analyses provided in Technical Memorandum No. 1 pointed out specific problem areas that would be encountered in 1986 and in the year 2005. The analyses indicated that travel in the year 2005 would be heavier than in 1986 due to the expected continued increase in non-CIA "background traffic". The analyses showed level of service values at key intersections and access routes in the study area. The changes in these levels between 1986 and 2005 indicate the severity of the conditions now and the potential deterioration over the next 20 years.

This previous analysis is the basis for the development of action-oriented transportation improvements. It provides the rationale for considering a range of alternative improvements that can provide adequate highway transportation for this portion of Fairfax County.

It must be kept in mind that long range highway planning is normally carried out on a regional basis. On the other hand transportation planning related to an individual site would generally deal with direct access to the site. However, given the location of the CIA adjacent to several major regional facilities, it is difficult to totally separate CIA access needs from separate, but related regional needs. In some cases these needs overlap although it is important that the two requirements be kept clearly in mind.

The alternatives that are addressed in this report are oriented to improving access to the CIA which in turn will permit the regional highway facilities in this area to function at reasonable service levels. A number of alternatives have been developed which range from "do nothing" or very modest operational improvements to more extensive reconstruction of particular intersections or key access links.

^{1/} Analysis of the Projected Levels of Traffic Service Based on the Expansion of the CIA Headquarters, Dewberry & Davis and JHK & Associates, November 1983.

The purpose of this report is to identify those alternatives which are technically feasible, define their basic engineering, economic, and social characteristics, indicate the manner in which they would satisfy the forecast traffic loads and graphically depict how they would be incorporated into the existing road network.

From a purely planning standpoint any number of highway alternatives are possible. However, from the practical standpoint, many options are not socially, economically or technically feasible when placed under close scrutiny. In this report a wide range of alternatives are addressed, even though some are not considered viable candidates. This approach was used to present an appraisal of the potential benefits and consequences which could be expected from the range of alternatives that are available. This report is meant to provide the basic information for each alternative from which an informed decision can be made for a recommended course of action.

II. ROADWAY IMPROVEMENT ALTERNATIVES

STUDY AREA

Four segments of the existing study area roadway network will be impacted by expansion of the CIA complex. These are shown in Figure 1 and described below:

- Capital Beltway (I-495) outer loop from the George Washington Memorial Parkway (GWMP) interchange south to the Route 193 interchange.
- Capital Beltway (I-495) inner loop from GWMP interchange north across the Cabin John Bridge.
- CIA access interchange with the GWMP.
- Route 123 intersections with the CIA entrance, Route 193 and Potomac School Road and the Turkey Run Access Road intersection with Route 193.

AREAS IMPACTED BY CIA EXPANSION AND DESCRIPTION OF IMPACTS

Technical Memorandum No. 1 previously presented an analysis of traffic problems brought about by the CIA expansion and increases in background traffic to the year 2005. The following summarizes the traffic impacts which would occur if no improvements were made to the existing highway system.

GWMP Interchange with Capital Beltway

Under all potential future traffic conditions, the ramp connections from the Parkway to the Beltway will continue to operate at unsatisfactory levels of service. Consequences will include extensive traffic queues extending down the Parkway for long distances easterly of the interchange with the Beltway. These impacts will occur with or without the CIA expansion traffic.

Capital Beltway North and South of GWMP Interchange

Normal traffic growth plus increased traffic from the CIA expansion will result

in unsatisfactory service levels on the Beltway outer loop between the Parkway interchange entrance ramp and the Route 193 exit ramp. Congestion within this section will be due to the heavy volume of traffic entering the Beltway from the Parkway in the P.M. peak period along with the heavy volumes using the Beltway mainline. The inner loop of the Beltway from the Parkway across the Cabin John Bridge will be similarly, though not as severely, affected. The ramp merge from the Parkway to the inner loop is the primary problem area on the inner loop.

GWMP/CIA Access Interchange

Heavy traffic volumes on the Parkway and on the westbound entrance ramp from the CIA to the westbound Parkway in the P.M. peak period, in conjunction with substandard design features, will result in unsatisfactory operations. The consequence would include queuing of traffic on the westbound entrance ramp waiting to enter the Parkway.

Route 123 Intersections with CIA Entrance, Route 193 and Potomac School Road

CIA expansion, along with overall traffic growth, will result in significant increases in congestion at these intersections. Particularly significant would be the deterioration of several service levels on Route 123 eastbound in the A.M. peak period between the Route 193 intersection and the CIA entrance, and similar congestion in the P.M. period in the reverse direction. Also resulting would be extensive queuing of traffic along the exit roads from the CIA complex. Increases in traffic will also aggravate conditions at the intersection of Potomac School Road and Route 123.

PROGRAMMED ROADWAY IMPROVEMENTS

Two significant improvements to the Capital Beltway are currently programmed by the Virginia Department of Highways and Transportation (VDH&T) and the Maryland State Highway Administration (MSHA) which will have an influence on the alternatives being evaluated. These improvements are:

- **Cabin John Bridge** - VDH&T and MSHA have programmed the widening of the Cabin John Bridge to provide four lanes in each direction with shoulder areas for disabled vehicles. A 4-F statement for this project has been completed and design is underway. Funds for construction have been programmed with completion scheduled for 1986. Consequently, this project has been accepted as a given when formulating and evaluating alternatives.
- **Capital Beltway from GWMP to the Cabin John Bridge** - A related roadway improvement will be constructed by VDH&T. This will involve the widening of the present Beltway inner and outer loops so that four thru lanes are provided continuously between the George Washington Memorial Parkway and the Cabin John Bridge. This project is also accepted as a given in the study although the potential consequences on traffic flows are described.
- **George Washington Memorial Parkway** - The National Park Service has abandoned plans for extending the GWMP beyond the Beltway. Right-of-way acquired for this purpose is being disposed of; therefore, no consideration of the possible extension of the GWMP outside the Beltway was given in the study.

ROADWAY IMPROVEMENTS EXCLUDED FROM CONSIDERATION

George Washington Memorial Parkway

Capacity restraints at the GWMP Interchange with the Beltway impose limitations on the volume of traffic which can enter the Beltway from the Parkway. The only way to remove these restraints would be to again widen the Beltway beyond reasonable and practical limits. This factor, combined with the abandonment of plans for extending the Parkway outside the Beltway, preclude consideration of widening the Parkway from Route 123 or the CIA entrance north to the Beltway since such a widening would not increase capacity at the most critical points and would thus be of no benefit.

Route 193 (Old Georgetown Pike)

Old Georgetown Pike has been designated a Virginia Historic Byway. Plans have been prepared for safety upgrading of the road but no increased capacity will result. Under these circumstances, widening of Route 193 was not considered as a viable candidate for consideration in the Study. However, providing a grade separation between eastbound Route 193 and westbound Route 123, a past and future objective of VDH&T, was thoroughly investigated.

ROADWAY IMPROVEMENT ALTERNATIVES

Several alternative improvements to the roadways in the problem areas were developed and evaluated. These alternatives were designed to address the traffic problems identified in Technical Memorandum No. 1, and span the range of improvement types, from minimal to very extensive.

Capital Beltway/GWMP Interchange

Three alternatives were developed and evaluated for this location. They are shown on Figures 2 through 4 and described below:

Alternative 1 - Four Lane Beltway with Standard Acceleration Lane for the GWMP on-ramps (Figure 2)

With this scheme, four through lanes in each direction would be provided through the GWMP interchange and across the Cabin John Bridge. Standard acceleration and deceleration lanes for all entering and exiting ramps of the Capital Beltway/GWMP Interchange would be provided except for the ramp from the GWMP to the southbound Beltway. This acceleration lane would be of substandard length to avoid decreasing horizontal clearances at the Service Road bridge over the Beltway.

Alternative 2 - Four Lane Beltway with Auxiliary Lane Between Interchange (Figure 3)

With this Alternative, the Beltway would be widened so that four through lanes plus an auxiliary lane in each direction would be provided from the GWMP Interchange across the Cabin John Bridge. A fifth lane on the outer loop of the Beltway between the GWMP and Route 193 interchange would also be provided. The currently programmed widening of the Cabin John Bridge would be utilized to provide the added lane on the structure. No shoulders for disabled vehicles would be provided on the Bridge and the horizontal clearances beneath the Service Road bridge would be very substandard.

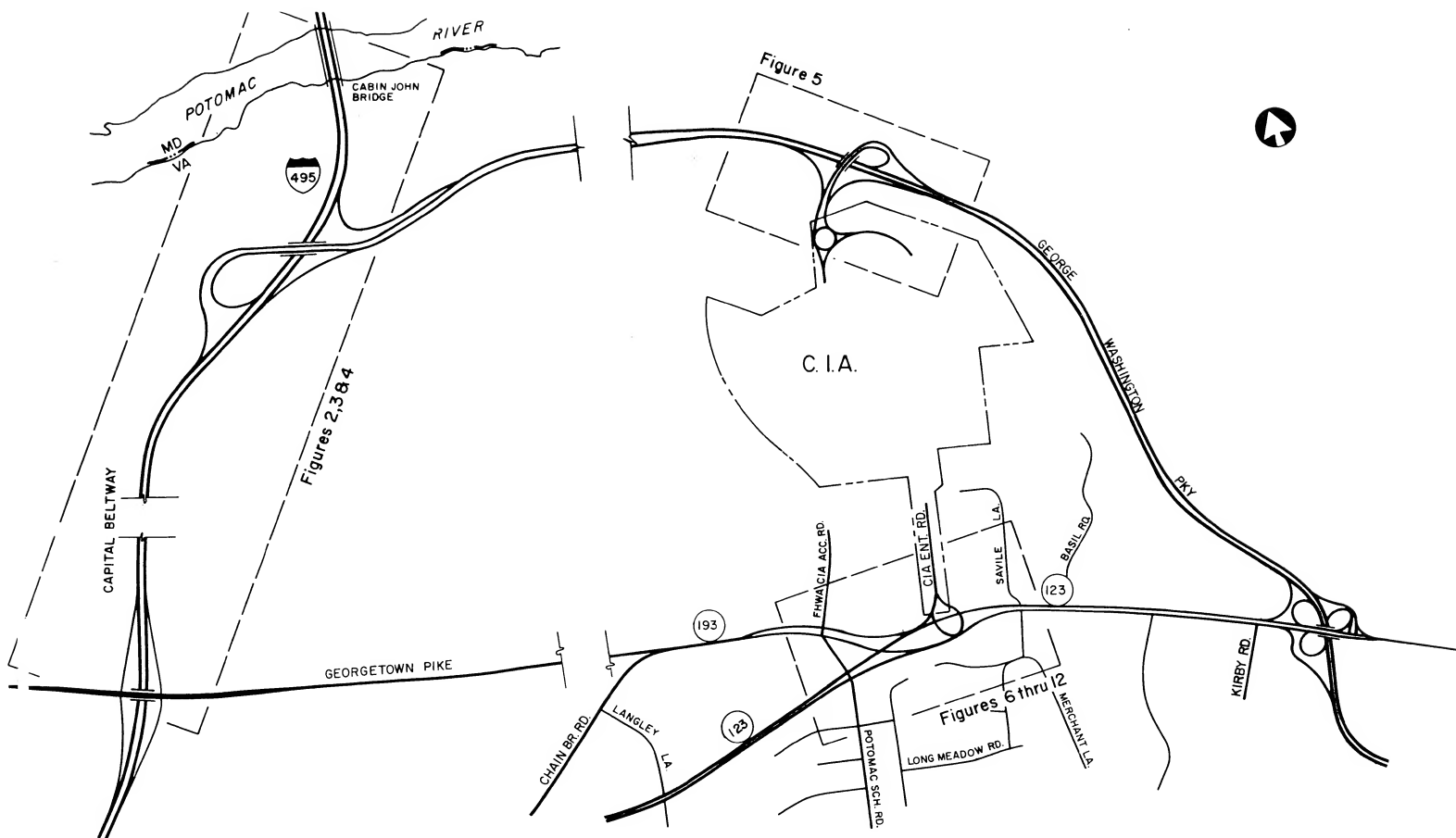
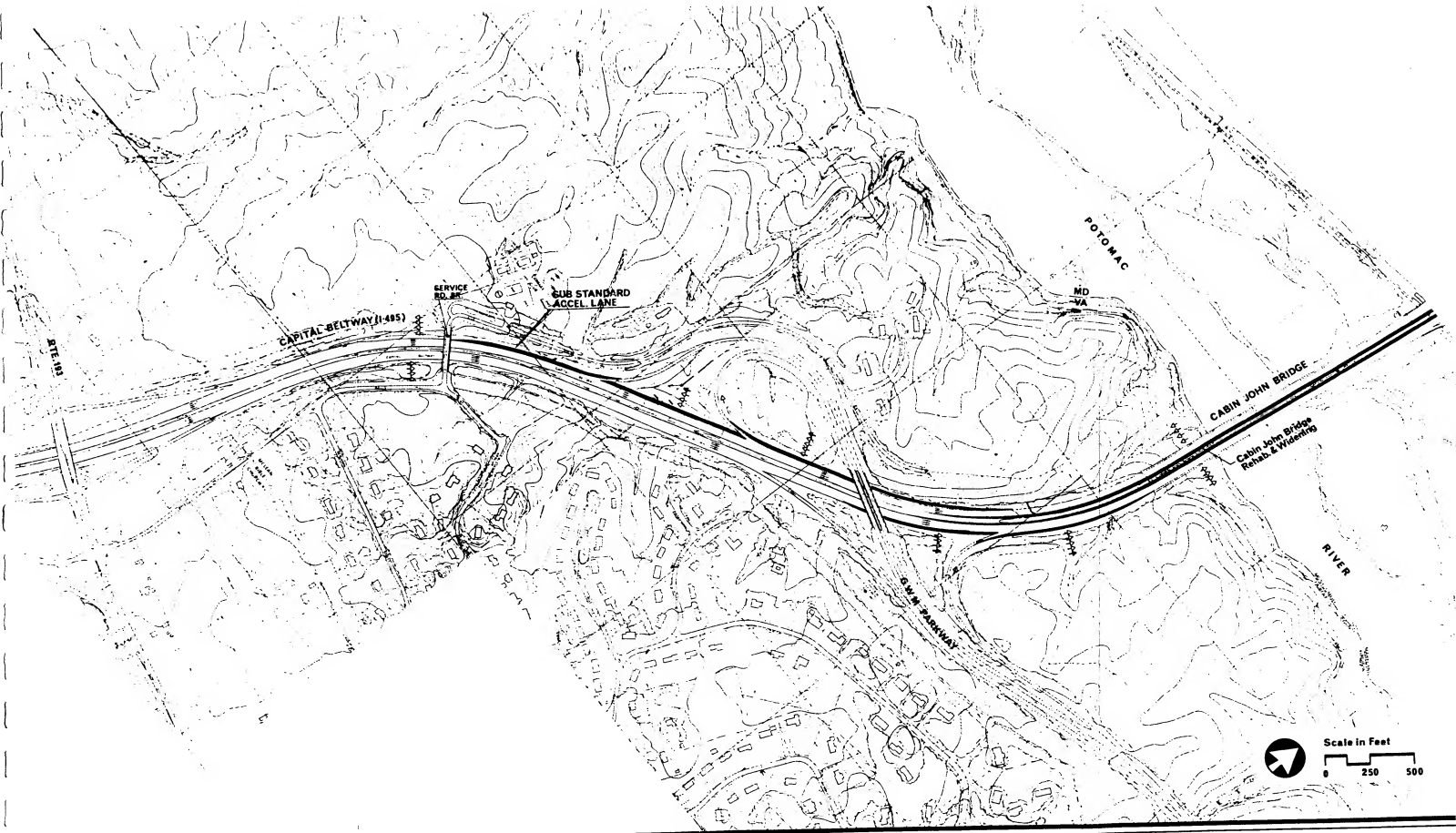


Figure 1

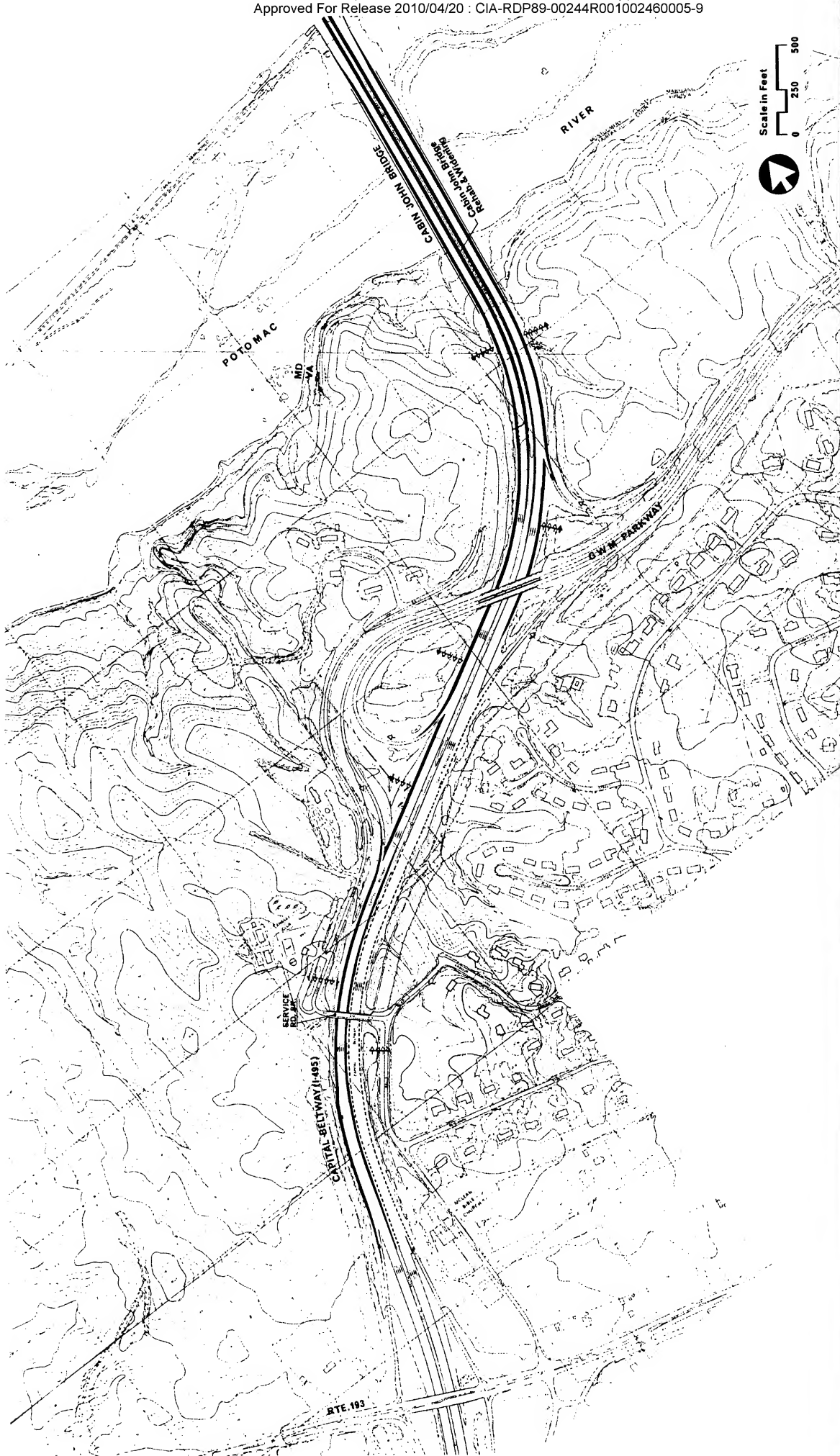
Roadway Elements Evaluated
For Improvement to Provide
Additional Capacity For
CIA Expansion



LEGEND
— Proposed Roadway
— Existing Roadway to be Maintained
x x x Abandoned Roadway

ALTERNATIVE 1
Capital Beltway (I-495) Interchange
With GWM Parkway

Figure 2



ALTERNATIVE 2
Capital Beltway (I-495) Interchange
With GWM Parkway

LEGEND
— Proposed Roadway
- - - Exist. Roadway to be Maintained
X X X Abandoned Roadway

Figure 3

Alternative 3 - Four Lane Beltway with Weaving Between GWMP and Route 193 Eliminated (Figure 4)

This concept would involve four through lanes plus a maneuvering lane in each direction across the Cabin John Bridge. Extensive modifications to the outer loop of the Beltway between the GWMP and Route 193 interchanges would be required in order to eliminate the weaving of traffic exiting at Route 193. This concept would require replacement of the Service Road bridge over the Beltway since insufficient clearance is available to permit the modification required and would involve relocation of Live Oak Drive with attendant significant costs and disruption.

GWMP/CIA Entrance Interchange - (Figure 5)

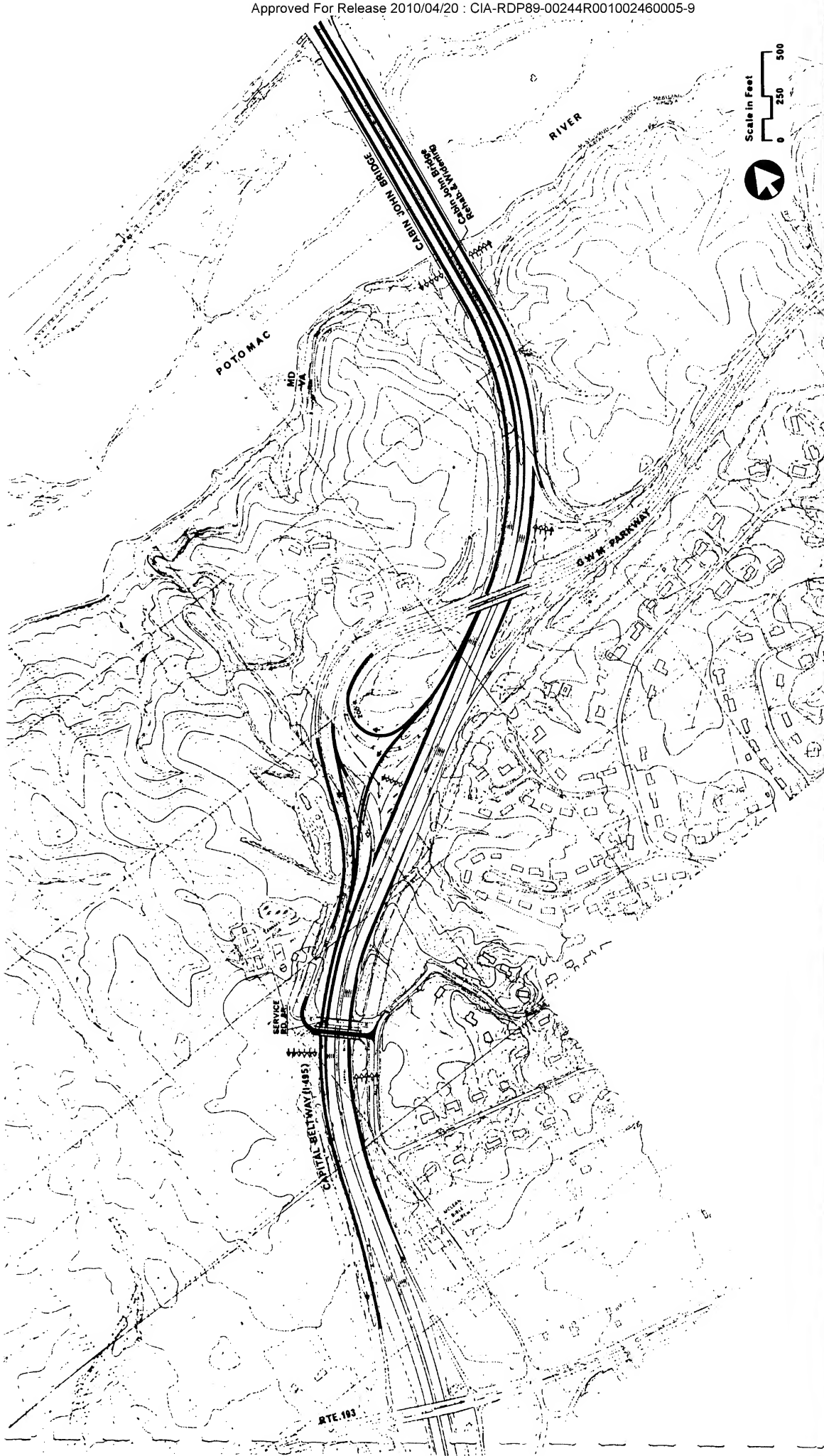
Upgrading of the entrance ramps to the Parkway are suggested. Involved is widening the northbound GWMP on the median side and utilizing the existing right lane of the outbound Parkway as an acceleration lane. Also required is widening along the right side of the GWMP southbound ramp to provide an adequate acceleration lane.

Route 123/Route 193/CIA Entrance

Seven preliminary alternatives were evaluated for the segment of Route 123 from Potomac School Road to Merchant Lane, which includes the CIA entrance from Route 123. Improvements to the FWHA/CIA Access Road at Route 193 and three lanes in each direction along Route 123 within these limits are elements of all alternatives.

Alternative 1 - Basic At-Grade Improvements - (Figure 6)

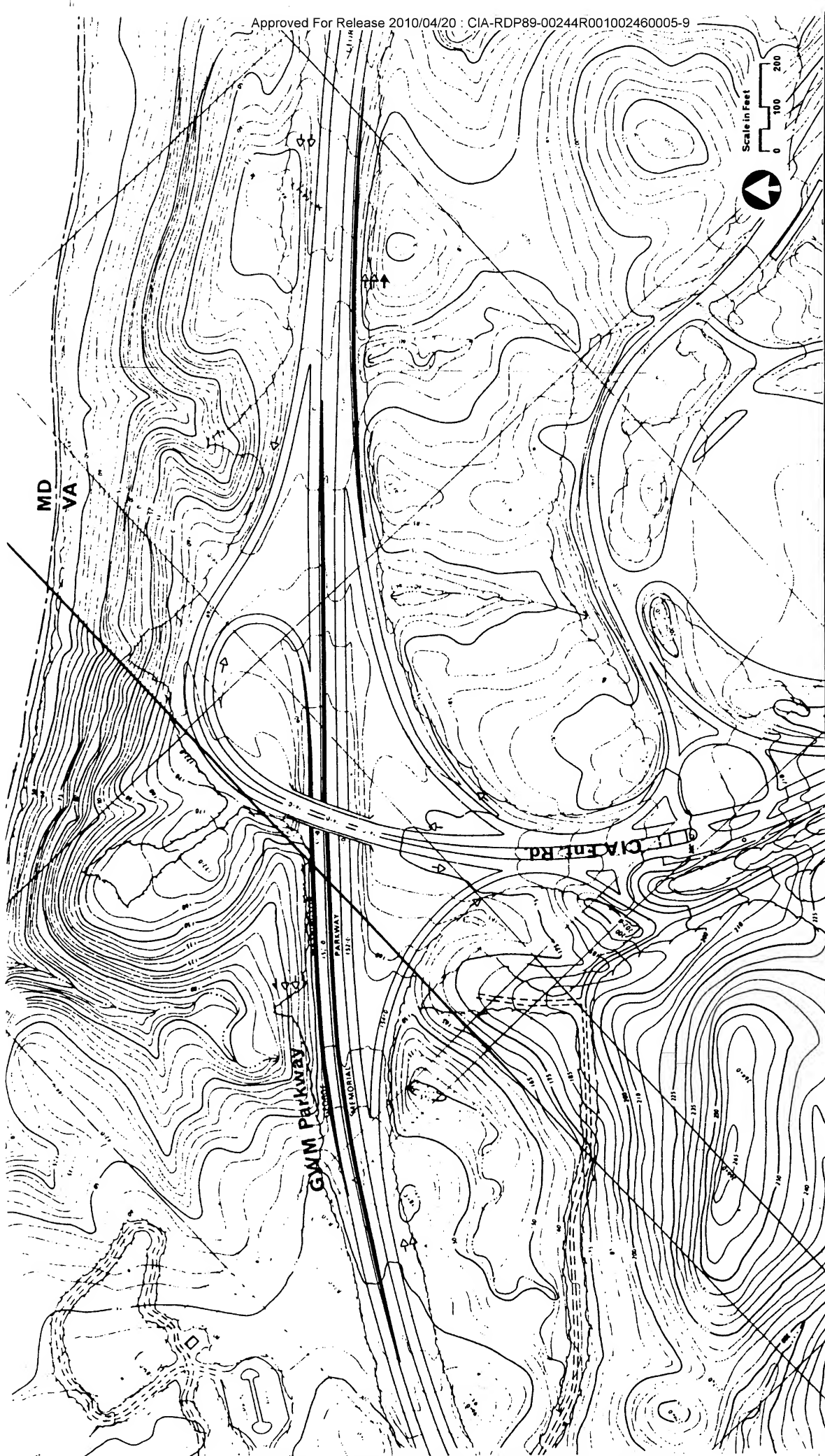
Alternative 1 represents the lowest level of improvements evaluated as a candidate to provide improved service levels along Route 123 at the CIA entrance. In general, this scheme involves widening of existing roadways to provide additional through and turning lanes. However, the connection between Routes 123 and 193 would be realigned westerly to increase the length of the weaving and merging areas



ALTERNATIVE 3
Capital Beltway (I-495) Interchange
With GWM Parkway

LEGEND
 — Proposed Roadway
 - - - - - Exist. Roadway to be Maintained
 X X X Abandoned Roadway

Figure 4



ALTERNATIVE 1

Improvements to CIA Access
Interchange with GWM Parkway

LEGEND
— Proposed Roadway
--- Exist. Roadway to be Maintained

Figure 5

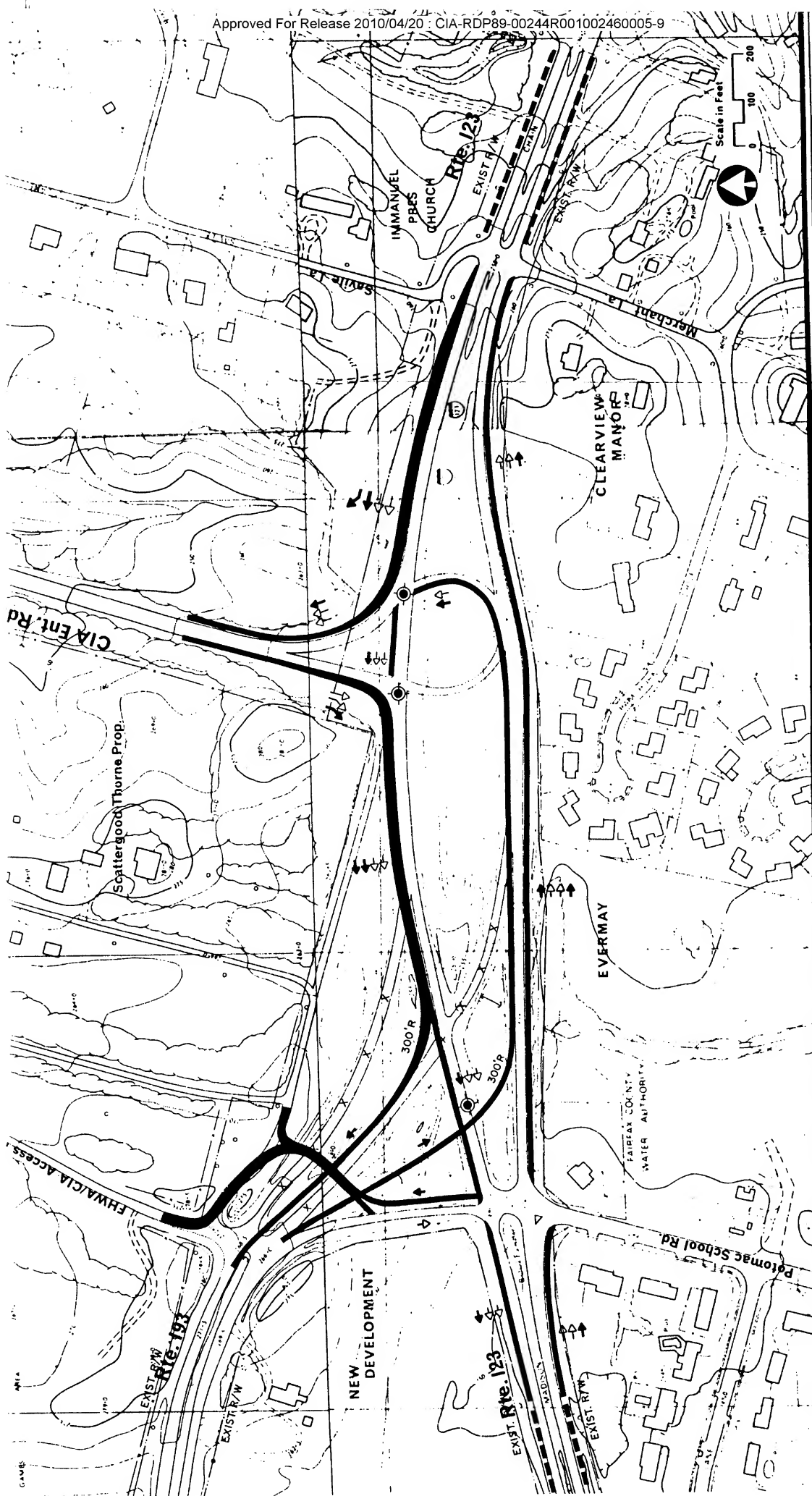


Figure 6

between Route 193 and the CIA entrance intersections. No operational improvement of the existing Potomac School Road intersection would be provided although a direct connection from Potomac School Road to westbound 193 is possible.

Alternative 2 - At-Grade T Intersections (Figure 7)

This concept would involve realignment and reconstruction of most of the existing roadways to provide two conventional T-intersections with signal controls. Multiple turning lanes would be provided where required to achieve adequate levels of service. The signal installations would be interconnected to provide optimum efficiency. Potomac School Road intersections would be aligned opposite relocated Route 193 which would afford opportunity for signal control of all turning movements and for pedestrian crossings. The existing roadways not affected would be westbound Route 123 and the CIA entrance road, although both would require widening.

Alternative 2A - (Figure 7)

With this scheme Alternative 2 would be modified to incorporate a grade separation between Eastbound Route 193 and Westbound Route 123, consistent with past and future planning objectives for the Virginia Department of Highways and Transportation. The CIA entrance intersection would be the same as with Alternative 2. The Potomac School Road intersection at Route 123 would not be signalized, similarly to Alternative 4.

Alternative 3 - Trumpet Interchange Option 1 (Figure 8)

This alternative would involve construction of a trumpet interchange between Route 123 and the CIA entrance road. Route 193 would be realigned to intersect Route 123 opposite Potomac School Road. This intersection would require signal control. A single grade-separation carrying Route 123 over the ramps in and out of the CIA complex would be provided.



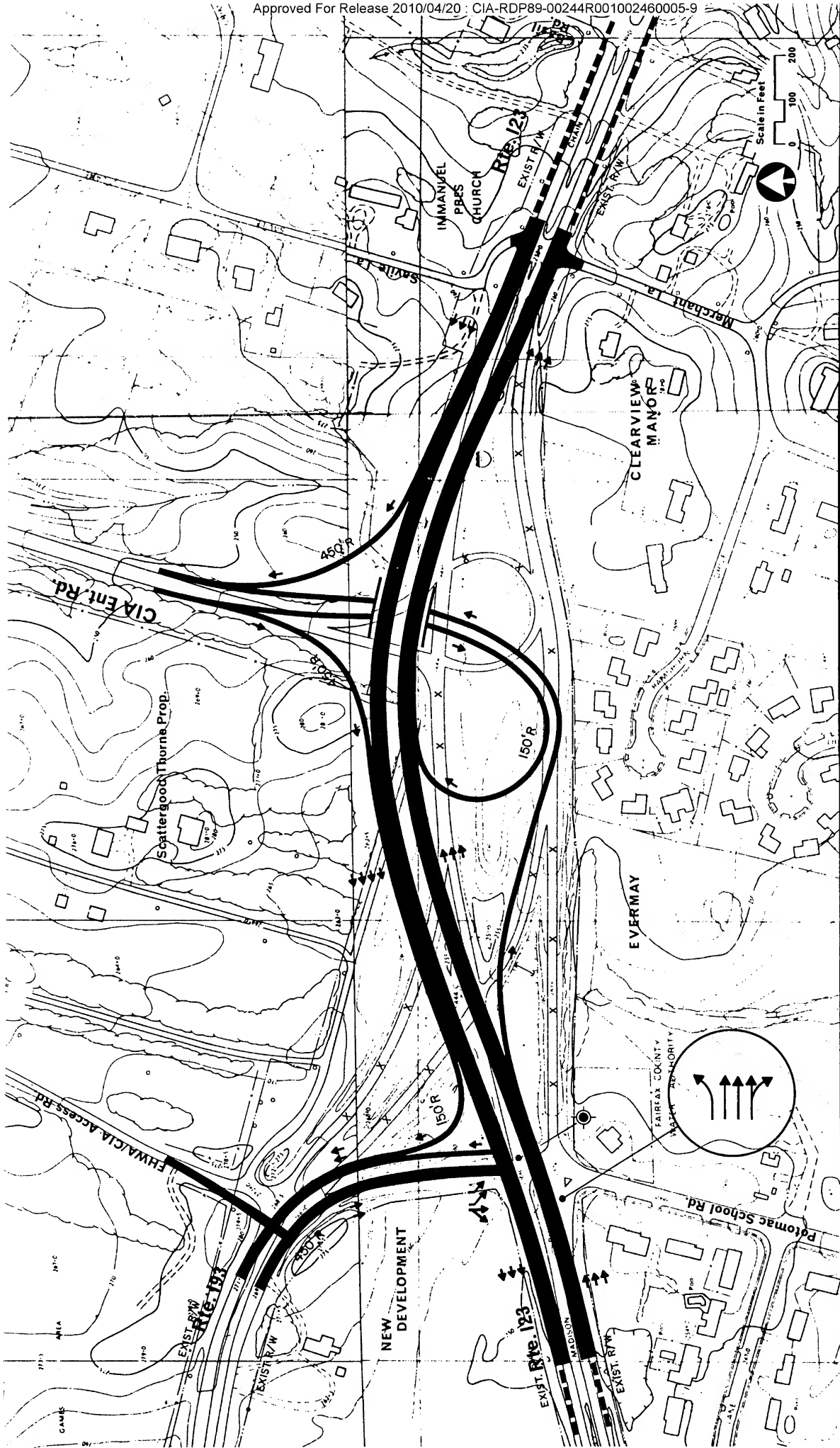


Figure 8

LEGEND

- Proposed Roadway
- Exist. Roadway to be Maintained
- Traffic Signal
- Abandoned Roadway
- Ultimate Widening Outside Study Limits

ALTERNATIVE 3

Route 123/Route 193 CIA Entrance

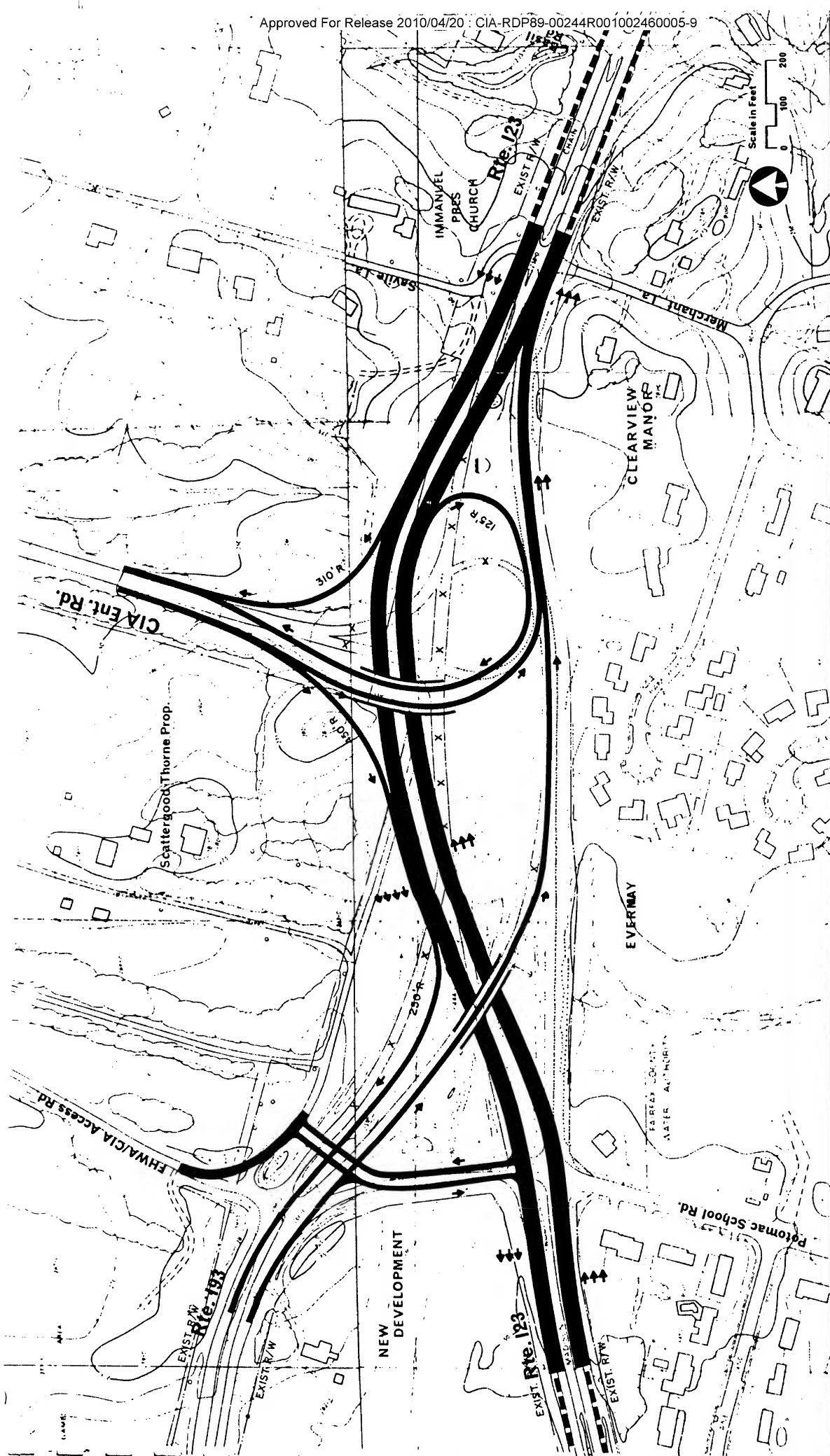


Figure 9

ALTERNATIVE 4 **Route 123/Route 193 CIA Entrance**

Alternative 4 - Trumpet Interchange Option 2 (Figure 9)

This concept is similar to Alternative 3 except that the loop ramp configuration is reversed. This would permit a grade separation between the eastbound Route 193 and westbound Route 123 roadways. This advantage is offset by the reduced weaving distance on Route 123 westbound between the CIA exit and Route 193 and by the somewhat reduced geometric design standards which would be required to minimize grade changes and right-of-way requirements. No signal would be required at the Route 123 intersection with Potomac School Road.

Alternative 5 - Three-Bridge Option (Figure 10)

This scheme involves realignment of the Route 193 connections to Route 123, realignment of the access ramps to the CIA, and the grade separation of these three connections from the westbound Route 123 roadway. Both directional roadways of Route 123 would be widened and the merging and weaving distances along eastbound Route 123 would be increased. The Potomac School Road intersection with Route 123 would be retained.

Alternative 6 - Tri-Level Bridge Option (Figure 11)

This scheme involves a multi-legged, complex interchange with grade separations to eliminate all grade crossings and most weaving between traffic entering and leaving Route 123 to the CIA or to Route 193. A three-level grade separation would be involved. The Potomac School Road intersection at Route 123 would be limited to right turns in and out. This would result in rerouting of local trips via subdivision streets to the Merchant Lane intersection, a significant disadvantage. This scheme and Alternative 7 represent the range of highest cost and most complexity when compared with the other alternatives.

Alternative 7 - (Figure 12)

This concept is a variation of Alternative 6 that permits realignment of Route 193 opposite Potomac School Road and therefore allows retention of and improvement

to this intersection. This concept is also an extreme measure compared to the at-grade alternatives.

PEDESTRIAN CONSIDERATIONS

The section of the Fairfax County Comprehensive Plan which deals with hiking and biking trails suggests a trail through the Study Area. More specifically, the Plan would locate a hiking and biking trail along Route 193 to its intersection with Route 123 and then along the north side of Route 123 to the GWMP. All of the roadway improvement alternatives described above could incorporate provisions for this hiking and biking trail. However, this facility could more readily be accommodated with the at-grade alternatives 1, 2 and 2A. Alternative 3, 4 and 5, which include grade separations, could accommodate the hiking and biking trail more easily than 6 and 7.

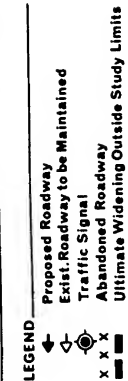
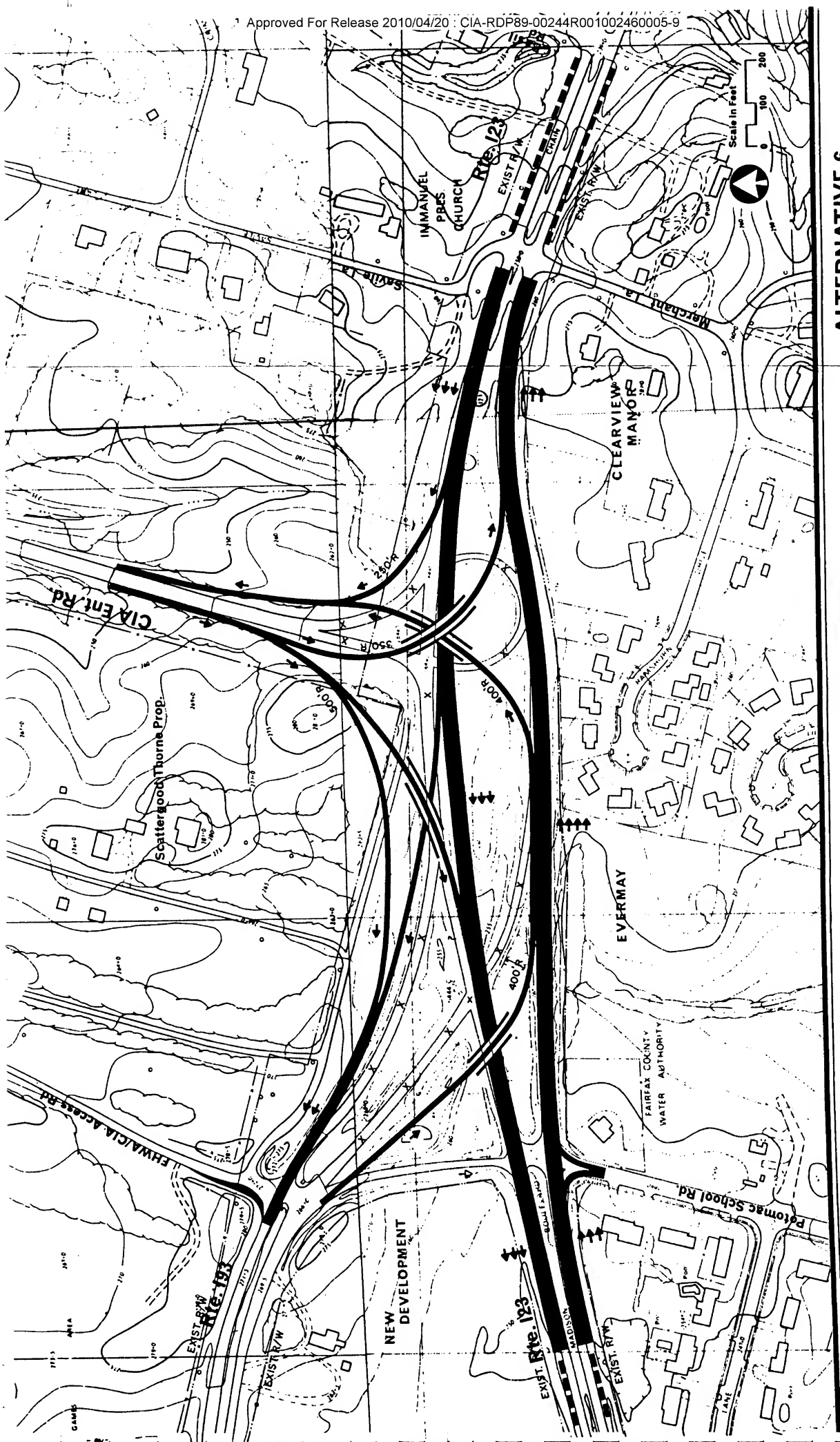


Figure 10

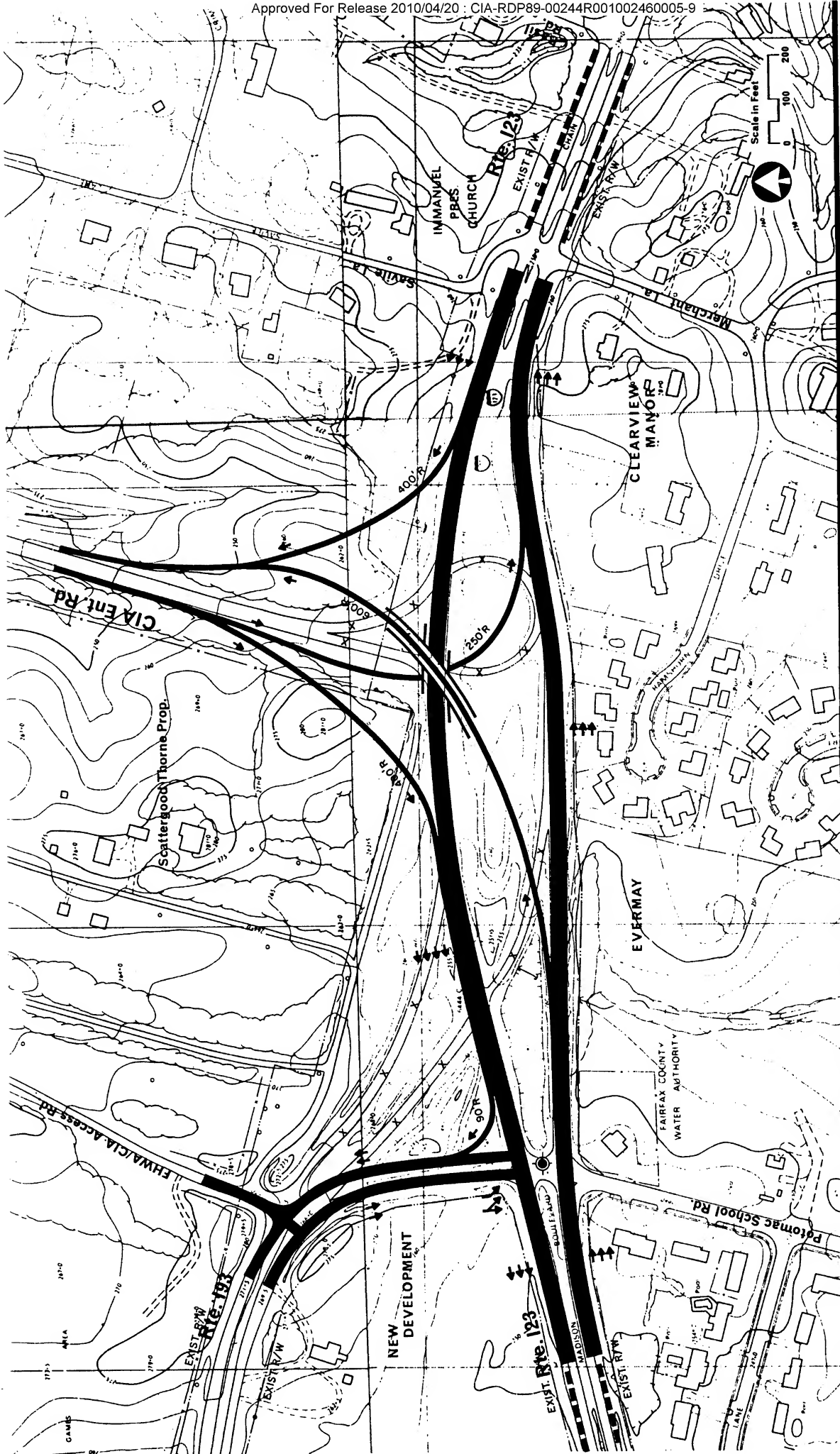


ALTERNATIVE 6 Route 123/Route 193 CIA Entrance

LEGEND

- Proposed Roadway
- Exist. Roadway to be Maintained
- Traffic Signal
- Abandoned Roadway
- Ultimate Widening Outside Study Limits

Figure 11



ALTERNATIVE 7

Route 123/Route 193 CIA Entrance

- LEGEND
- Proposed Roadway
 - Exist. Roadway to be Maintained
 - Traffic Signal
 - Abandoned Roadway
 - Ultimate Widening Outside Study Limits

Figure 12

III. TRAFFIC ANALYSIS OF ALTERNATIVES

ANALYSIS METHODOLOGY

Technical Memorandum No. 1 presented an overview of how a traffic impact analysis is typically conducted. It also described the results of the first several steps of the traffic analysis being conducted for the CIA expansion, including the forecast of traffic volumes and the level of service analysis for three forecast traffic conditions, assuming that no improvements are made to the existing roadway network. The purpose of that analysis was to identify locations where roadway improvements were likely to be necessary to accommodate the increase in both CIA traffic and non-CIA background traffic.

The analysis described in this chapter represents a detailed examination of a range of improvement alternatives. Each alternative discussed in Chapter II is evaluated with respect to the levels of traffic service it provides. A summary of the level of service impacts, along with the cost to construct, potential environmental consequences, and other factors, is provided in Chapter IV.

In Technical Memorandum No. 1, three future traffic conditions (capacity restrained, unrestrained, and all expansion traffic entering via the G. W. Parkway) were examined for two design years (1986 and 2005). In addition, a "no-build" condition was examined for the year 2005 to enable the determination of the impact of the CIA expansion on highway needs. The primary emphasis of the traffic analysis in this Technical Memorandum is on the long-range 2005 impacts under the capacity restrained condition and the unrestrained condition, with the no-build condition also examined for purposes of comparison. The condition of all expansion traffic being assigned to the Parkway (termed the "GW" condition in Technical Memorandum No. 1) is clearly unrealistic in light of the continuing capacity constrained conditions which will occur at the I-495/G.W. Parkway interchange into the foreseeable future. It is felt that the most likely future traffic condition will be somewhere between the capacity constrained and the unrestrained condition. The 1986 forecast year will be used in a subsequent stage of the project to determine the timing of the implementation of certain improvements.

LEVEL OF SERVICE ANALYSIS

The level of service analysis was conducted using the same basic procedures as were used in Technical Memorandum No. 1. This included analyses of intersections, weaving areas and freeway ramp merges. Because of the more detailed level of analysis in this phase of the project, two different capacity analysis procedures were used to analyze intersections. In addition to the procedures in Transportation Research Circular 212, the procedures from the 1965 Highway Capacity Manual were also used. The Circular 212 procedures are interim procedures until the new Highway Capacity Manual is adopted, and the 1965 Capacity Manual procedures provide a basis for comparison. The results indicate only minor differences.

The results of these analyses are reported in a series of tables, two tables for the I-495/GWMP interchange area, and two tables for various locations along Route 123 between the CIA and Potomac School Road. Each improvement alternative is discussed separately, beginning with the I-495 interchange alternatives, and ending with the Route 123 alternatives.

Alternatives for I-495 Southbound at the GWMP Interchange

Chapter II presented three improvement alternatives for the Capital Beltway/GWMP Interchange area, oriented around future plans for the Cabin John Bridge. The results of the level of service analysis are presented separately for the southbound and northbound directions of the Beltway because there are unique problems which must be addressed for each direction.

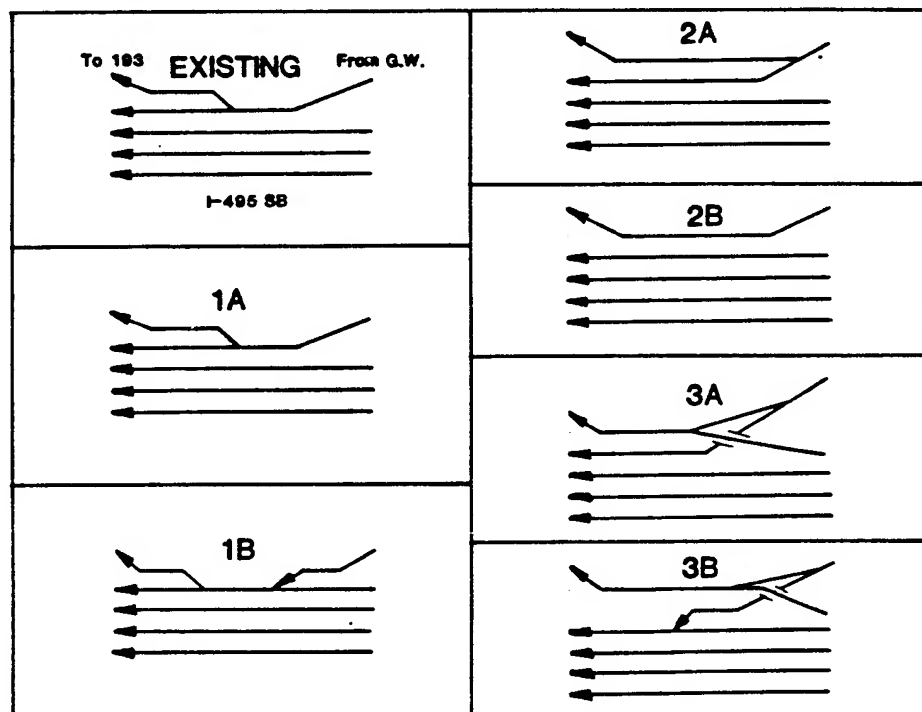
The results of the level of service analysis for southbound I-495 between the GWMP and Route 193 are shown in Table 1. Results are presented for the PM peak hour only as there are no significant operational problems in the AM peak hour through this section. Three alternatives are presented with two sub-options each, one with no lane drop at the GWMP off-ramp and another assuming that there is a lane drop. Although the alternatives presented for the Beltway in Chapter II assumed no lane drop (i.e. included a full four-lane mainline from the Cabin John Bridge to Route 193), it was felt that an analysis of what would happen if there were a lane drop at the GWMP off-ramp would provide some very helpful insights on how this section would operate under various conditions. As will be seen in Table 1, there are some significant differences in operation between the lane drop and no lane drop conditions.

Table 1. Levels of Service on I-495 SB Between G.W. Parkway and Route 193

Improvement Alternative	CR ML/Ramp	P.M. Peak Hour UR ML/Ramp	NB ML/Ramp
<u>Existing Geometrics</u> ^{1/}	F/D-E	F/E-F	F/D-E
1. 4-lane C.J. Bridge, no widening between G.W.&193 A-lane drop at G.W. off B-no lane drop	F/D-E C/F	F/E-F C/F	F/D-E C/F
2. 4-lane C.J. Bridge, aux. lane between G.W.&193 A-lane drop at G.W. off B-no lane drop	E/D-E C/F	F/E-F C/F	E/D-E C/F
3. 4-lane C.J. Bridge w/braided ramp A-lane drop at G.W. off B-no lane drop	D/D C/F	D/F C/F	D/D C/F

Note: A.M. peak levels of service are all in A range

^{1/} letter to left of slash represents level of service for non-weaving traffic or mainline traffic; letter to right of slash represents level of service for weaving traffic or ramp traffic

LANE DIAGRAMS

One additional note should be made about Table 1. As indicated, there are two level of service values shown for each future traffic condition. The value to the left of the slash represents the level of service which would occur for the mainline lanes of the Beltway. The value to the right of the slash represents the level of service which would occur for the GWMP on-ramp (actually, this level of service would also occur for any mainline traffic weaving across GWMP ramp traffic to exit at Route 193). The distinction in levels of service between mainline and ramp traffic is an important one to make if one is to fully understand how this section will operate. Some alternatives adversely affect either the mainline or ramp, while others create more of a balance between the two. Specific alternatives are discussed below.

Alternative 1 - Four-lane Cabin John Bridge, no Widening Between GWMP and Route 193

Under this alternative, there would be an acceleration lane for GWMP ramp traffic merging into the I-495 southbound mainline. This differs from existing operation in that there is currently an exclusive lane for the ramp, added to three mainline lanes. This alternative would produce a greatly improved flow on the mainline of the Beltway, but would result in severe congestion on the northbound GWMP. If the projected demand for the year 2005 were to occur, it is estimated that the queue on the Parkway would extend five to ten miles down the Parkway from the I-495 interchange each evening.

If a lane drop were provided at the GWMP off-ramp with an exclusive lane for the Parkway ramp, the mainline would revert to an F condition. The Parkway ramp would still be at an F condition, due to the high volumes on the ramp (slightly over 2000 vehicles per hour for the CR and NB conditions and 2800 vehicles per hour in the UR condition). However, if these traffic demands were to occur, the queuing on the Parkway would be substantially less for the situation with the exclusive lane for the Parkway. Obviously, neither situation is desirable.

Alternative 2 - Four-Lane Cabin John Bridge with Auxiliary Lane Between the GWMP and Route 193

This alternative provides a complete fifth lane between the Parkway and the Route 193 off-ramp. The primary advantage of this option is that it would provide a

more adequate weaving area and a longer distance for GWMP ramp traffic to merge into the mainline. However, because of the high ramp volumes, the Parkway ramp will remain at a very poor level of service F, still with long queues down the Parkway. If a lane drop is provided, the mainline level of service will be slightly improved over Alternative 1, due to the better weaving area, but will still be at level E or F.

Alternative 3 - Four-Lane Cabin John Bridge with Grade-Separation of GWMP and Route 193 Off-ramp Traffic

Alternative 3 would enable the elimination of the weaving movements between the GWMP ramp and traffic exiting at Route 193. In the situation without a lane drop, this provides even a slightly better level of service C for the mainline traffic, but a poor F still would exist for the GWMP ramp merge. If a lane were to be dropped at the Parkway/193 off-ramp, a level of service D would still be provided on the mainline while the ramp level of service would range from D under the restrained condition to a marginal F under the unrestrained condition. This would relieve potentially severe congestion problems on the Parkway, but significant queues could still be expected if the demand approaches what is expected under the unrestrained condition. The only other way to relieve the potential problems in this area is to build alternate facilities elsewhere or to provide a major reconstruction of this entire length of the Beltway. These options are out of the scope of consideration for this study. Analysis indicates that an auxiliary lane on the inner loop between Route 193 and the GWMP exit is not needed to provide satisfactory service levels.

GWMP Ramp to Northbound I-495

This ramp is experiencing problems during both the AM and PM peak periods. Table 2 indicates the levels of service for the ramp and the mainline under the two basic alternatives.

Alternative 1 - Four-Lane Cabin John Bridge

The widening of the Cabin John Bridge will significantly improve the levels of traffic service on the mainline of the Beltway northbound. The level of service for the ramp from the GWMP, however, will be F for both the morning and evening peak

Table 2. Levels of Service on I-495 NB at G.W. Parkway On-Ramp

Improvement Alternative	A.M. Peak Hour		P.M. Peak Hour		
	UR ML/Ramp	NB ML/Ramp	CR ML/Ramp	UR ML/Ramp	NB ML/Ramp
Existing Geometrics	F/F ^{2/}	F/F	D/F	D/F	D/F
1. <u>4-lane C.J. Bridge</u> no aux. lane for G.W. aux. lane for G.W. ^{1/}	D/F F/B	D/F F/B	B/F C/C-D	B/F C/D	B/F C/C
2. <u>5-lane C.J. Bridge</u> four thru lanes plus aux. lane for G.W.	C/B	C/B	B/C-D	B/D	B/C

^{1/} assumes lane is dropped upstream of G.W. Parkway ramp
^{2/} letter to left of slash represents level of service on mainline lanes. Letter to right of slash represent ramp level of service where there is an auxiliary lane or ramp plus lane 1 level of service where there is a standard acceleration lane.

hours. This problem will not be critical in the morning peak period, since volumes on the Parkway to northbound I-495 are relatively light. This could be more of a problem in the PM peak period, however, with the heavy outbound volumes from the Parkway. An auxiliary lane for the Parkway ramp would, of course, greatly improve ramp level of service. However, it would seriously degrade the AM mainline level of service. Although a four-lane cross-section for the bridge may be sufficient to serve traffic over the short term, it appears that there may eventually be a need to provide five lanes on the bridge, as described under the next alternative.

Alternative 2 - Five-Lane Cabin John Bridge

With a five-lane Cabin John, an auxiliary lane could be provided for the Parkway on-ramp to northbound I-495. This lane would link with the off-ramp to the Maryland side of the Parkway, and the Beltway mainline would continue with four lanes into Maryland. Both the AM and PM peak hours would be provided with a good level of service with this configuration. The major disadvantage is the elimination of shoulders on the bridge to accommodate breakdowns. Should a five-lane cross-section be considered in the future the relative merits of having a shoulder versus providing an improved level of service will have to be weighed. The VDH&T has recommended to the MSHA that five lanes plus 10 foot shoulders each side be provided on the improved bridge. The expansion of the CIA does not affect any of the decisions regarding the Cabin John Bridge.

Route 123 Alternatives

Tables 3 and 4 show the levels of traffic service for the seven Route 123 alternatives. Levels are indicated for the capacity restrained, unrestrained and no-build conditions for the year 2005 for both the Circular 212 and 1965 Capacity Manual procedures. Each table also includes an analysis of what the levels of service would be if no improvements were made to the existing highway system (Circular 212 procedure only). The result shown in the tables are based on a six-lane Route 123 for each alternative. An analysis was also conducted assuming a four-lane Route 123, but it was found that a four-lane cross-section was not adequate to handle year 2005 traffic.

Table 3. Levels of Service at Locations Along Route 123 for AM Peak Hour in 2005

Improvement Alternative	Intersection Location					
	CIA IN UR/NB ^{1/}	CIA OUT UR/NB	EB Weaving 193 to CIA UR/NB ^{3/}	WB Weaving CIA to 193 UR/NB ^{3/}	Rt. 193 UR/NB	Potomac School Rd. UR/NB
No Improvement ^{4/}	D/C	A/A	DE/CE	NA	B/B	C/C
At - Grade						
1 - Basic imprvmts. 1965 Cap. Man. Circular 212	A/A A/A	A/A A/A	BE/BD	NA NA	A/A A/A	A/A A/A
2 - T intersections 1965 Cap. Man. Circular 212	C/A ^{2/} B/A	NA ^{2/} NA	NA NA	NA NA	NA ^{5/} NA	D/C ^{6/} C/C
Grade - Separated						
3 - Trumpet op. #1 1965 Cap. Man. Circular 212	A/A A/A	A/A A/A	NA NA	A/A A/A	NA ^{5/} NA	D/C C/C
4 - Trumpet op. #2 1965 Cap. Man. Circular 212	A/A A/A	A/A A/A	NA NA	A/A A/A	A/A A/A	A/A A/A
5 - 3 Bridge option 1965 Cap. Man. Circular 212	A/A A/A	A/A A/A	BE/BD	A/A A/A	A/A A/A	C/C A/A
6 - Tri-level option 1965 Cap. Man. Circular 212	A/A A/A	A/A A/A	BE/BD	NA NA	A/A A/A	NA NA
7 - 1965 Cap. Man. Circular 212	A/A A/A	A/A A/A	NA NA	A/A A/A	NA ^{5/} NA	D/C C/C

1/ A/A = level of service for two traffic conditions: unrestrained/no-build

2/ CIA out combined with CIA in

3/ levels of service for weaving section are provided for both weaving and non-weaving traffic - first letter is for non-weaving traffic, second letter is for weaving traffic

4/ Based on procedures in Circular 212

5/ Combined with Potomac School Road intersection

6/ Under Alternative 2A (Route 193 routed over Route 123 to the east of Potomac School Road) levels of service would be A's at Potomac School Road.

Table 4. Levels of Service at Locations Along Route 123 for PM Peak Hour in 2005

Improvement Alternative	Intersection Location					
	CIA IN CR/UR/NB ^{1/}	CIA OUT CR/UR/NB	EB Weaving 193 to CIA CR/UR/NB	WB Weaving CIA to 193 CR/UR/NB	Rt. 193 CR/UR/NB	Potomac School Rd. CR/UR/NB
No Improvement^{4/}	F/D/E	F/F/F	AD/AD/AD	NA	F/D/E	E/C/D
At - Grade						
1 - Basic imprvmts. 1965 Cap. Man. Circular 212	A/A/A B/A/B	D/A/B D/C/D	AC/AC/AC	NA NA	B/A/A C/B/C	C/A/A B/A/B
2 - T intersections 1965 Cap. Man. Circular 212	D/D/D ^{2/} D/C/C	NA ^{2/} NA	NA NA	NA NA	NA NA	C/A/A ^{6/} C/B/B
Grade - Separated						
3 - Trumpet op. #1 1965 Cap. Man. Circular 212	A/A/A A/A/A	A/A/A A/A/A	NA NA	DE/BE/CE	NA NA	C/A/A C/B/B
4 - Trumpet op. #2 1965 Cap. Man. Circular 212	A/A/A A/A/A	A/A/A A/A/A	N/A N/A	DE/BE/CE	A/A/A A/A/A	
5 - 3 Bridge option 1965 Cap. Man. Circular 212	A/A/A A/A/A	A/A/A A/A/A	AC/AC/AC	DE/BE/CE	A/A/A A/A/A	C/A/A B/A/B
6 - Tri-level option 1965 Cap. Man. Circular 212	A/A/A A/A/A	A/A/A A/A/A	AC/AC/AC	NA NA	A/A/A A/A/A	NA NA
7 - 1965 Cap. Man. Circular 212	A/A/A A/A/A	A/A/A A/A/A	NA NA	DE/BE/CE	NA NA	C/A/A C/B/B

^{1/} A/A/A = level of service for three traffic conditions: capacity restrained/unrestrained/no-build

^{2/} CIA out combined with CIA in

^{3/} levels of service for weaving section are provided for both weaving and non-weaving traffic - first letter is for non-weaving traffic, second letter is for weaving traffic

^{4/} Based on procedures in Circular 212

^{5/} Combined with Potomac School Road intersection

^{6/} For Alternative 2A, level of service at Potomac School Road would be the same as for Alternative 1. Grade separation would provide level of service A at Route 193/Route 123 interchange.

demands under any of the alternatives. The intersection of Route 123 and the Turkey Run Access Road will operate satisfactorily in year 2005 assuming the widening of the Turkey Run approach.

Several items in the tables require explanation. First, it should be noted that where traffic movements have been separated with bridge structures in Alternatives 3 through 7, the levels of service have been designated as A's. This is to indicate that there is essentially no delay incurred for those movements under the indicated alternatives. Second, the tables present two level of service values for the weaving sections analyzed, rather than the one letter given for intersection levels of service. The first letter of each pair represents the level of service for weaving traffic, while the second letter represents the level of service for other non-weaving traffic. The reason for presenting both service levels separately is that certain improvement alternatives may significantly improve one type of traffic (non-weaving traffic, for example), but provide no improvement for other traffic. Although providing two level of service values may take more time for the reader to absorb, it will provide a more complete understanding of how each alternative affects traffic flow. An "NA" in Tables 3 or 4 indicates a situation which will not exist under that alternative.

Tables 3 and 4 can be used in several ways. For example, comparisons can be made of the changes in levels of service among alternatives by examining any given column of values. Comparisons can also be made between the CR, UR and NB future traffic conditions to determine how the CIA expansion will affect the level of service for any alternative. For the AM peak hour, simply compare the UR and NB values. For the PM peak hour, the CR and NB conditions should be the primary ones compared since the NB condition contains most of the same assumptions in background traffic as the CR. The tables are used in the discussions which follow to describe each individual alternative.

Alternative 1 - Basic At-grade Improvements

The basic improvements provided by alternative 1 will result in a marginally acceptable level of service at the CIA entrance. Both capacity analysis procedures indicated a D service level in 2005 under the CR condition in the P.M. peak hour. Service levels for all other intersections along Route 123 will be acceptable for both peak hours assuming a 6-lane cross-section.

The weaving section on the eastbound link of Route 123 between Route 193 and the CIA will operate well for non-weaving traffic, but only at level of service D to E for weaving traffic in the AM peak hour. Although the D to E weaving service level is not as serious a problem on Route 123 as it would be on a freeway, some queuing and/or degradation of speeds will be noticeable in this and other weaving sections. In fact, this section of Route 123 will be a potential problem for weaving traffic under any option which retains this as a weaving section, due to the crossing of the traffic movements from Route 123 eastbound to the CIA and from Route 193 to Route 123 eastbound. Alternative 1 holds an advantage over alternatives 5 and 6 in that the weaving section is slightly longer, but the weaving section could still receive interference from backups from the traffic signal at Route 123.

Although the levels of service are acceptable under alternative 1, (marginally acceptable at the CIA entrance in the PM peak hour) there are several deficiencies relative to the other alternatives. It does not relieve the current difficulty of vehicles and pedestrians crossing Route 123 at Potomac School Road. This could possibly be overcome by the installation of a signal at that intersection, but the signal is not warranted and would, if installed, result in four closely spaced signals along Route 123, a highly undesirable situation. The alignment of the connection between Potomac School Road and westbound Route 193, shown in order to eliminate the present circuitous access between the two roads, is not ideal. The worth of this alternative will probably rest with how the Potomac School Road intersection should be treated and on the acceptability of service levels at the CIA entrance.

Alternative 2 - "T" Intersections at the CIA and Potomac School Road

This is the other major at-grade alternative. It reduces the number of intersections along Route 123 to two, and essentially eliminates the weaving areas both eastbound and westbound. The major trade-off is the increased volume that passes through the intersections when they are consolidated. The levels of service are in the marginally acceptable range at both intersections under CR traffic conditions, given a 6-lane Route 123. As with all the other alternatives, a fourth lane must be added westbound between the CIA and Route 193, and a fourth approach lane to the CIA entrance is also provided under this alternative.

The advantages of this option include the more standard intersection configuration, elimination of weaving and the improved accessibility and safety provided for the Potomac School Road intersection. The most significant disadvantage is the increased delay to some traffic movements, particularly the Route 193 southbound to Route 123 eastbound movement, which will not be as direct as it is currently. Alternative 2A, shown by dashed lines in Figure 7, would alleviate this problem by taking Route 193 over Route 123, east of the Potomac School Road intersection. This would improve the level of service at Potomac School Road and reduce delay for Route 193 and Route 123 traffic.

Alternatives 3 - Trumpet Interchange No. 1

The primary advantages of the Alternative 3 trumpet interchange are the improved level of service provided at the CIA entrance and the elimination of the eastbound weaving section. Route 193 would be aligned with Potomac School Road, providing the same benefits as Alternative 2 but also having to accommodate the same heavy traffic volumes. In addition, Alternative 3 introduces a new weaving section, this being Route 123 westbound between the CIA entrance and Route 193. Although this might be considered to be a type of weaving section right now, it currently has the assistance of a traffic signal, which alternates the traffic movements between the CIA exit traffic and the Route 123 westbound traffic, thereby substantially reducing the weaving effect. Because of the relatively short length of this section and the heavy volumes involved, the level of service for weaving traffic is projected to be in the E range. A 6-lane section of Route 123 is required to maintain level of service D for non-weaving traffic under the CR condition in the PM peak hour. A signal could be installed at the CIA exit to assist CIA exiting traffic, but this would not appear to be in keeping with the grade-separation concept. Overall, however, it would be expected that the trumpet interchange as well as the other grade-separation options, would significantly reduce traffic delay.

Alternative 4 - Trumpet Interchange No. 2

Alternative 4 provides a trumpet-type grade separation at the CIA entrance and a bridge for Route 193 traffic over westbound Route 123. The advantage of this option over Alternative 3 is that it removes the Route 193 traffic from the Potomac School Road intersection, both reducing Route 193 delay and improving the level of

service at Potomac School Road. Two-way access between Route 193 and Route 123 would be provided. The primary problem remaining with this option would be the short weaving section on Route 123 westbound between the CIA and Route 193. To obtain the full benefits of this and other grade-separated options, the weaving sections should be allowed to operate as true weaving sections, but a yield sign could be provided for the entrance ramps should congestion problems develop on Route 123. In addition, the crossing problem at Potomac School Road is retained.

Alternative 5 - Three Bridge Option

This alternative would provide easier access across westbound Route 123 for Route 193 and CIA traffic. The primary disadvantages are that it retains the eastbound Route 123 weaving section and creates a weaving section westbound, once the signal at the CIA exit is removed. In addition, it retains the existing configuration at Potomac School Road, with its crossing and safety problems. The direct access across Route 123 to Route 193 would relieve the current circuitry problem but the geometric design is not ideal.

Alternatives 6 and 7

These additional grade-separated options provide an improved level of traffic service over some other options, but retain at least one or two of the undesirable features. Alternative 6 keeps the eastbound weaving section and, in fact, provides the shortest weaving length of any option. Alternative 7 for the Potomac School Road intersection has exactly the same characteristics as at-grade alternative 2 as well as grade-separated options 3 and 4.

SUMMARY OF TRAFFIC ANALYSIS

The following represents a summary of the most important findings from the analysis of potential highway improvements. The I-495/G.W. Parkway interchange area is discussed first, followed by the section of Route 123 between the CIA entrance and Potomac School Road.

Under virtually any improvement alternative, the interchange of I-495 with the George Washington Parkway will continue to experience severe traffic problems into the future. Although the current problems on I-495 northbound can be alleviated somewhat through the forthcoming Cabin John Bridge widening project, such is not true for the weaving area on I-495 southbound between the Parkway and Route 193. Several major improvements to the southbound direction were considered, including an additional auxiliary lane and a braided exit ramp configuration to eliminate weaving traffic. However, the costs and probable right-of-way and environmental impacts of these options are significant when compared to the small benefit obtained.

The southbound direction of I-495 between the Parkway and Route 193 should receive further study in the context of the overall regional transportation network. It is likely to become one of the major bottlenecks on the Beltway in the future if alternate routes are not constructed or if some other major improvements are not made. One important observation is that any configuration on the Beltway that does not allow for an exclusive lane from the Parkway will result in congestion on the Parkway which is much more severe than exists at that interchange today. This should be a significant consideration in the final design of the southbound Cabin John Bridge project and its integration with the Parkway interchange.

The basic conclusion of the analysis of Route 123 and its intersections with the CIA, Route 193 and Potomac School Road is that any of the options, including the at-grade options with a 6-lane Route 123, could effectively accommodate traffic demand, even the capacity-restrained condition. However, the at-grade options are not as flexible as the grade separated options since they are predicted to operate at marginally acceptable levels of service, and could not be easily upgraded should the traffic volumes prove to be higher than the projections. The primary advantage of the grade-separated alternatives over the at-grade alternatives is in the reduced traffic delay incurred. Traffic will incur less delay with the grade separated alternatives since there will be fewer traffic signals and therefore a lower probability of stopping. The primary trade-off, of course, is the substantially greater costs of the grade-separated alternatives. Under any of the alternatives, problems crossing Route 123 will continue to exist at Merchants Lane and at Potomac School Road under unsignalized conditions.

The following summarize the important findings for each of the improvement alternatives along Route 123:

. At-grade alternative 1 -

- provides C-D level of service with 6-lane section of Route 123, with a marginally acceptable level at the CIA entrance, under the CR condition
- weaving area on eastbound 123 between Route 193 and the CIA entrance may still be a problem
- intersection with Potomac School Road still poses safety problems, unless signalized.

. At-grade alternative 2 -

- provides C-D level of service with 6-lane section of Route 123, with marginally acceptable levels at both intersections under the CR condition
- the intersection with Potomac School Road becomes a major focal point of traffic flow. Delays will significantly increase for Route 193 eastbound traffic, which is diverted through the Potomac School Road intersection. Although traffic through this intersection would increase, it has the advantage of providing greater safety and accessibility for Potomac School Road traffic and for pedestrians
- only this alternative and alternatives 3, 4 and 7 eliminate the AM weaving problem on eastbound Route 123

. Alternative 2A -

- alleviates the most significant problem with Alternative 2 by providing a grade separation of Route 193 and Route 123
- otherwise is the same as Alternative 2

. Grade-separated Alternative 3 -

- this trumpet interchange option has the advantage of providing a good level of service at the CIA entrance and also solving some of the accessibility and safety problems at Potomac School Road. The level of service at Potomac School Road is only marginally acceptable, however. The major remaining traffic problem is the westbound weaving section between the CIA and Route 193.

. Grade-separated Alternative 4 -

- provides improved level of service for Route 193 traffic and at Potomac School Road over Alternative 3
- retains short weaving section on westbound Route 123

. Grade-separated Alternative 5 -

- the two major remaining problems with this alternative are the weaving sections northbound and southbound between Route 193 and the CIA. A six-lane section is still needed to accommodate the weaving volumes, and these will operate no better than the weaving sections under the at-grade options.
- this option retains the safety and accessibility problems at Potomac School Road. The crossing problem for both vehicles and pedestrians could be solved only with a traffic signal, which would interrupt flow on Route 123.

. Grade-separated Alternatives 6 and 7

- These alternatives, which grade-separate traffic movements in a different manner than the other alternatives, retain one or more of the same deficiencies as the other alternatives. In the case of alternative 6, the eastbound weaving section is the shortest of any of the seven options. For alternative 7, the westbound weaving section is retained.
- as with the other grade-separated options, alternatives 6 and 7 would reduce traffic delay through the elimination of traffic signals but would incur substantially greater costs than the at-grade options and with more right-of-way impact.

IV. COMPARISON OF ROADWAY IMPROVEMENT ALTERNATIVES

Presented in Tables 5 and 6 is a quantitative and qualitative comparison of the roadway improvement alternatives considered at the Beltway/GWMP Interchange and along Route 123 between the CIA entrance and Potomac School Road. This provides a basis for comparing the various alternatives in a broad range of categories ranging from costs, which can be quantified, to environmental consequences, which are qualitative in nature. In addition to the table summarizing the impacts, the following conclusions are offered:

GWMP/Capital Beltway Interchange

- Practical limitations on the type and extent of Beltway improvements imply that the most probable traffic condition for CIA access trips is a distribution somewhere between the capacity restrained and unrestrained conditions at the GWMP Interchange with the Capital Beltway.
- The currently programmed rehabilitation and deck widening on the Cabin John Bridge will enhance traffic operations over the short term. Ultimately, it will be necessary to provide four through lanes plus an auxiliary lane for maneuvering vehicles northbound across this Bridge as indicated by Alternative 2 in order to maintain satisfactory service levels.
- Elimination of the exclusive lane from the Parkway on-ramp to southbound I-495 will result in extreme congestion on the Parkway entrance ramp. The conditions would be less severe if a lane drop from four to three lanes is provided at the Parkway off-ramp. However, retaining the lane drop is in conflict with the objective of providing four through lanes in each direction continuously around the Beltway in Virginia and Maryland.
- Measures which would be required to provide adequate capacity to accommodate the Parkway connection to the Beltway at normally acceptable levels of service are of scale and magnitude as to be outside the scope of this study.

TABLE 6

COMPARISON OF ALTERNATIVES

ROUTE 123/ROUTE 193/CIA ENTRANCE

ALTERNATIVE	DESIGN FEATURES	SERVICE LEVEL AT ROUTE 193 INTERSECTION WITH ROUTE 123	SERVICE LEVELS AT OTHER SELECTED LOCATIONS	COST (Million Dollars)	R-O-W(1) REQUIREMENT	COMPATIBILITY	ACCOMMODATIONS FOR PEDESTRIANS	IMPACTS ON		ENVIRONMENTAL CONSEQUENCES
								IMPACTS ON CIA INTERNAL ROADWAYS	TRAFFIC DURING CONSTRUCTION	
1	Basic at grade improvements	Marginal	CIA - Marginal Potomac School Rd. - Adequate	\$1.1	None	Good	Unchanged	None	Moderate	Minimal
2	"T" Intersections at grade	Marginal	CIA - Marginal(2) Potomac School Rd. - Adequate	\$1.5	None	Good	Improved	None	Moderate	Minimal
2A	"T" Intersections at grade with grade separation of Eastbound 193 with Westbound 123	Adequate	CIA - Marginal Potomac School Rd. - Adequate	\$2.3	None	Good	Improved	None	Moderate	Minimal
3	Trumpet Interchange at CIA, major at grade intersection at Potomac School Rd.	Marginal	CIA - Adequate Potomac School Rd. - Adequate	\$4.4	Minimal	Acceptable	Improved	Moderate	Significant	Significant
4	Trumpet Interchange which also includes grade separation of Eastbound 193 and Westbound 123	Adequate	CIA - Adequate Potomac School Rd. - Adequate	\$5.1	Minimal	Acceptable	Unchanged	Moderate	Significant	Significant
5	Three bridge option: grade separation for CIA entering and exiting ramp and Southbound Route 193	Adequate	CIA - Adequate Potomac School Rd. - Adequate	\$3.7	Minimal	Questionable	Unchanged	Significant	Moderate	Significant
6	Tri-level grade separation: no weaving	Superior	CIA - Superior Potomac School Rd. - Inadequate	\$5.7	Significant	Unsatisfactory	Downgraded	Significant	Extensive	Extensive
7	Tri-level grade separation with at grade intersection at Potomac School Rd.	Adequate	CIA - Adequate Potomac School Rd. - Adequate	\$5.9	Significant	Unsatisfactory	Unchanged	Significant	Extensive	Extensive

(1) Alternatives 1 and 2 avoid encroachment on Scattergood Thorne Property - all others would have an impact.

(2) Service levels same as 1 but overall traffic operation and layout is superior. This is preferred at-grade solution.

T A B L E 5

COMPARISON OF ALTERNATIVESCAPITAL BELTWAY/GWMP INTERCHANGE

<u>ALTERNATIVE</u>	<u>DESIGN FEATURES</u>	<u>SERVICE LEVEL AT SELECTED LOCATIONS</u>	<u>COST (1) (Million Dollars)</u>	<u>R-O-W REQUIREMENT</u>	<u>SITE COMPATIBILITY</u>	<u>IMPACTS ON TRAFFIC DURING CONSTRUCTION</u>	<u>ENVIRONMENTAL CONSEQUENCES</u>
1	4 thru lanes on Beltway with acceleration and deceleration lanes	N.B. Ramp - Unsatisfactory S.B. Ramp - Unsatisfactory Capital Beltway Roadways Inner Loop - Marginal Outer Loop - Unsatisfactory	\$0.9	None	Good	Moderate	Minimal
2	4 thru lanes on Beltway with auxiliary lane on outer loop between GWMP and Route 193	N.B. Ramp - Adequate S.B. Ramp - Unsatisfactory Capital Beltway Roadways Inner Loop - Marginal Outer Loop - Unsatisfactory	\$2.0	None	Good	Moderate	Minimal
3	4 thru lanes on Beltway with auxiliary lanes between ramps and dual exit ramp to Route 193	N.B. Ramp - Adequate S.B. Ramp - Unsatisfactory Capital Beltway Roadways Inner Loop - Marginal Outer Loop - Unsatisfactory	\$4.5	Extensive	Unsatisfactory	Significant	Extensive

(1) Does not include cost of widening Cabin John Bridge already programmed by VDHT & MSHA

GWMP and GWMP/CIA Access Interchange

- Absence of an effective way to terminate a 6-lane GWMP at the Beltway, together with abandonment of plans for extending the Parkway outside the Beltway preclude consideration of widening the Parkway north of Route 123, as it would be of no practical benefit.
- Upgraded design of the entrance ramps linking the CIA access interchange with the Parkway should be undertaken at a cost of \$400,000. These will improve safety and upgrade operating characteristics at this location.

Route 123/Route 193/ CIA Entrance

- Increased traffic resulting from the CIA expansion, in conjunction with overall traffic growth, warrant improvements along Route 123. All of the alternatives which were evaluated will theoretically accommodate the projected traffic condition volumes for the year 2005. However, Alternatives 1 and 2 which involve only at-grade improvements are limited in their ability to handle traffic by the at-grade signalized intersections. Small increases in traffic volumes beyond those forecasted to occur could result in inadequate service levels at the critical intersections.
- The alternatives which include grade separations provide considerable additional capacity at the CIA entrance and, therefore, are more flexible in their ability to provide adequate service should traffic exceed levels forecasted for the capacity restrained condition. However, some of the grade separation alternatives retain a major at-grade intersection.
- Concentrating traffic movements at the Potomac School Road/Route 193/Route 123 intersection will result in considerable delays for some traffic movements when compared with travel times associated with the grade separated options, because of the multiple phase signals which would be required.

A P P E N D I X

STUDY PROCESS

Evaluation of CIA Access Improvements

